

# Social Media in Command & Control: An extended framework

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## ABSTRACT

Our research is aimed at investigating whether social media has a role to play in military Command & Control. Since social media is peer-to-peer, it could facilitate Network-Enabled Capabilities. A useful theoretical development is Reuter, Marx, and Pipek's (2011) proposal of a two-by-two matrix for social software infrastructure. Their framework assumes one-way communication and monolithic organizations. However, to operate in a real-time, dynamic environment, crisis management organizations must close the decision-making loop. Moreover, they must be structured into an action part that handles the crisis on-site, and a control part that monitors and directs operations in real time. The purpose of this work-in-progress paper is to present our extension of Reuter et al's framework. The paper outlines Reuter et al's framework, summarises the basic theory of Command & Control, describes how we extended Reuter et al's framework, and outlines further research.

## Keywords

Social media, crisis management, communication, Command & Control.

## INTRODUCTION

Much of scientific research on social media has been empirical and descriptive, i.e. it is focused on studying how citizens use social media "in the field". Around 2010, articles began to appear on the use of social media messages by commercial and public organizations, e.g. for marketing purposes or to broadcast a warning to the public in a defined area. The initial reaction of many organizations has been to see social media as a threat. Early adopters, however, realized that positive gains could be made using social media proactively. Marketeers, in particular, have taken to social media with enthusiasm, not only to monitor their target groups, but also to influence them. It is in this context that researchers, such as Kaplan and Haenlein (2010) and Kietzmann et al (2011), are currently developing theory for the organizational use of social media. By contrast, theoretical concepts about the use of social media for emergency management are in their infancy.

As in the wider organizational community, some emergency management and military organizations (e.g. US Marines) immediately banned the use of social media. Studies have now tempered the initial fears about employees violating information security (Brand, 2010). Military and emergency management organisations are starting to approach social media proactively. Clearly, it is the right moment to investigate the formal use of social media within emergency management processes. In this paper we report on the initial results of our research aimed at investigating the use of social media technology within the military Command & Control (C2) process. These results are likely to be applicable also to civil crisis and emergency management.

In military doctrine, the C2 process (supported by a C2 system) is defined as "*the exercise of authority and direction by a properly designated commander over assigned and attached forces in the accomplishment of the mission*" (US DoD, 2011). Some researchers have concluded that the peer-to-peer nature of social media cannot be reconciled with the top-down, directive nature of C2 systems. For example, Palen & Liu (2007, p. 727) state that "command-and-control models do not easily adapt to the expanding data-generating and -seeking activities by the public". We believe that their conclusion was premature precisely because it applied just to members of the public. Recently, Reuter, Marx, and Pipek's (2011) proposed a two-by-two matrix for the social software infrastructure supporting communication between citizens and organizations. We contend that if this framework is extended with cybernetic ideas about control systems then social media can be applied to C2 systems.

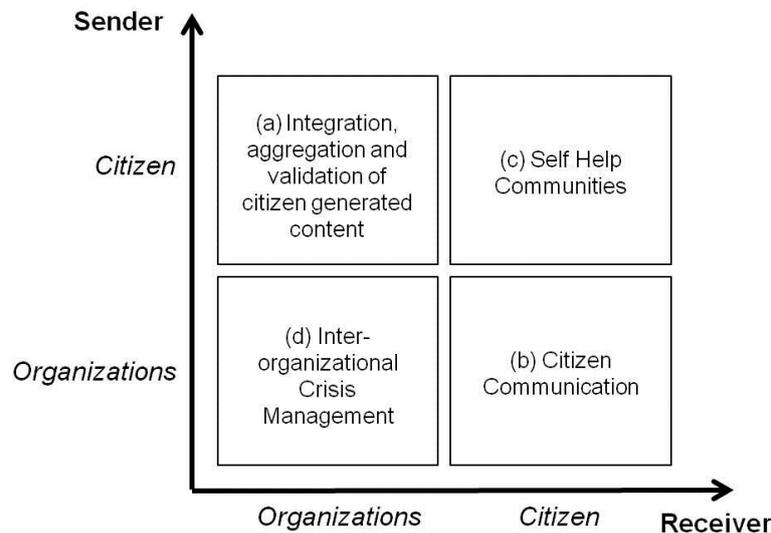
The purpose of this paper is to present our extension of Reuter et al's (2011) framework, incorporating basic ideas from C2 theory. This paper consists of five sections. After an introductory section, section 2 summarises Reuter et al's framework, and section 3 outlines relevant basic ideas of C2 theory. Section 4 combines Reuter et

al’s framework with C2 theory, showing how the resulting extension could be applied to a hypothetical, but realistic humanitarian crisis. Finally, section 5 draws conclusions and identifies areas for further research.

**REUTER ET AL’S (2011) FRAMEWORK**

Since Reuter et al’s (2011) theoretical contribution is central to the work reported here, we describe it in more detail. A review of the military C2 and equivalent emergency management literature (Jongejan & Grant, 2011) has not disclosed another framework specific to social media that could have been used as our starting point.

Reuter et al (2011) discuss how the professional actors involved in crisis management and the affected citizens can communicate and collaborate using social media. They define their term ‘social software’, identifying four types: wikis (e.g. Wikipedia), blogs / microblogs (e.g. Twitter), social networks (e.g. Facebook), and social sharing / collaborative keywording systems (e.g. Flickr and YouTube). Then they examine two case studies, identifying the strengths and weaknesses of social software in crisis management. Finally, they propose a concept for using citizens in crisis management with a social software infrastructure and a communication matrix. It is this last part of their paper that is relevant to our research.



**Figure 1. Communication matrix for social software infrastructure (Reuter et al, 2011, Fig 5).**

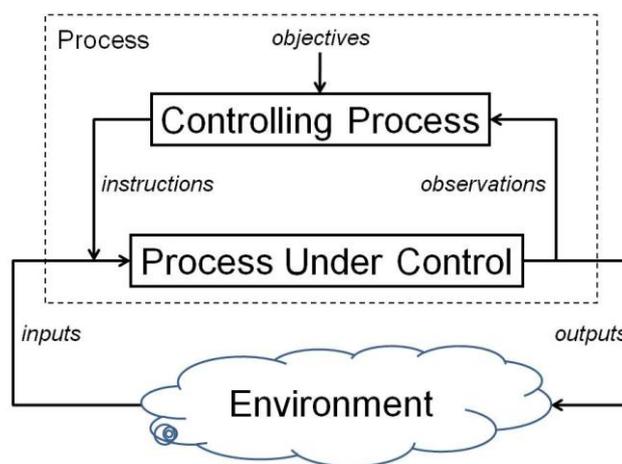
The goal of Reuter et al’s (2011) research is to recommend the creation of an infrastructure that integrates information from the different online communities and helps the official crisis management by providing and receiving information. Citizen-generated information could be integrated by monitoring social software with crisis tags, aggregating and validating the information against organization-generated information, and archiving relevant material for analysis and training. New activities enabled by social software would be the broadcasting of information from organizations to citizens, recommending crisis tags, requesting information from citizens, and supporting information brokers. Reuter et al propose the two-by-two matrix shown in Figure 1 as the basis for the social software infrastructure for communication between organizations and citizens.

In quadrant (a), citizen-generated content is integrated with and validated against the recipient organization’s own information, assisted where possible by the use of crisis tags previously provided to citizens by the organization. In quadrant (b), organizations broadcast information to inform, warn, and communicate with citizens, either as individuals or as groups. This would include the provision of crisis tags for citizens’ use. Quadrant (c) represents peer-to-peer communication between citizens, as employed in a crisis to provide self-help within (emergent) communities of interest. Communication in quadrant (d) supports information sharing between organizations for crisis management purposes.

**BASIC C2 THEORY**

Reuter et al’s (2011) framework models an organization as an atomic entity. However, all organizations have significant internal structure. Typically, three elements can be distinguished in emergency management and military organizations. A *policy element* – often closely linked to political decision making – sets the strategic goals. A *control element* acts to achieve those goals by gathering and assessing information from and giving instructions to the organization’s *action element*., i.e. the element responsible for acting in the crisis area. The organization is embedded in an environment containing the general public (and other objects). Citizens involved in the crisis interact directly with the organization’s action element.

We focus on the control and action elements, with policy being effectively fixed during a crisis. In systems theory (van Bertalanffy, 1968) – of which control theory is a specialization – a process exhibits behaviour by continuously exchanging inputs and outputs with its environment. In control theory (Ashby, 1956), a goal-oriented process can be split into two sub-processes: a Controlling Process (CP) and a Process Under Control (PUC). For the purposes of this paper, we map the control element of emergency management and military organisations with the CP, i.e. the commander and control team, and the action element with the PUC, i.e. his/her assigned and attached forces. Objectives are the goals set by the policy element (not shown).



**Figure 2. Relation between Controlling Process, Process Under Control, and Environment.**

Control theory distinguishes open- and closed-loop control and direct and supervisory control (Sheridan, 1992). Figure 2 depicts a closed-loop control system. Information flows from the environment, through the PUC where it is sensed and assessed, to the CP as observations, is compared with the objectives in the CP and transformed into commands to the PUC, which are then converted into output actions on the environment. The environment responds to these outputs by changing its state, which can again be sensed by the PUC. The loop from Environment to PUC and back is the *direct control* loop, and from PUC to CP and back is the *supervisory control* loop. To date, social media have played no role in closing these control loops (Jongejan & Grant, 2011).

**EXTENDING THE FRAMEWORK**

We refined Reuter et al’s (2011) framework by incorporating the C2 process, splitting organizations into two parts: CP and PUC. The result is the three-by-three matrix shown in Table 1. Reuter et al’s quadrant (c) remains the same, because citizen-to-citizen communications are unaffected by splitting the organization. We mark the citizens-to-CP and CP-to-citizens cells in Table 1 as “Not applicable” (“N/A”), because there is generally no direct communication from citizen to CP or vice versa<sup>1</sup>. We can now add the remaining three quadrants. On behalf of the organization, the PUC Integrates, Aggregates, and Validates Citizen-generated content – quadrant (a) – and also communicates to citizens – quadrant (b). When multiple organizations form a coalition, they

<sup>1</sup> An exception, if the geography allows, could be where the CP can communicate directly to the public. For example, the control room of a railway station or an airport may have the facility to instruct passengers by loudspeaker to evacuate the building in case of fire. However, a danger is that the CP may not be sited so that controllers can observe that the instruction has been correctly understood and acted upon.

collaborate or deconflict at CP-to-CP level<sup>2</sup>: quadrant (d). On-site, there may be communication PUC-to-PUC, e.g. to ensure that ambulances do not drive over the firefighter’s water supply pipes. This on-site communication can be interpreted in several ways. It can be interpreted as inter-organizational coordination, regarding the medical and fire services as separate organizations. Alternatively, if the medical and fire services are regarded as two parts of the same organizational entity (i.e. the emergency services), then this can be viewed as self-synchronization internal to that entity. We term this *Intra-organizational coordination* to reflect the parallels with Reuter et al’s Inter-organizational coordination.

		Receiver			
		Organizations		Citizens	
		CP	PUC		
Sender	Citizens		(N/A)	(a) Citizen-generated content	(c) Self-help
	Organizations	PUC	Observations (SITREPs)	On-site/ self-synchronization <i>(could be seen as (d) Intra-organizational coordination)</i>	(b) Citizen Communications
		CP	(d) Inter-organizational coordination	Instructions (Op orders/plans)	(N/A)

**Table 1. Extended framework for social media infrastructure.**

Applying social media to the three-by-three matrix (Table 1), the following picture emerges:

- Integration, Aggregation and Validation of Citizen-Generated Content represents the use of social media by citizens to provide inputs to the organization. Such inputs should be received by a call centre (c.f. handling of 911 calls) which integrates the validated and aggregated information with the organization’s own information before it is passed to the CP. The call centre is part of the PUC.
- Citizen Communications represents the use of social media by the organization to inform citizens in the crisis area. By analogy with marketing, this should be done by a team specialized in communicating with the public, based on CP-generated commands. Such a team is part of the PUC.
- Self-Help Communities represents the use of social media by citizens to communicate with other citizens in the environment. This is essentially unchanged by how the organization is structured.
- Inter-Organizational Crisis Management is a more complex case. Where two organizations are regarded as separate, then this is inter-organizational communication. By contrast, if they are regarded as parts of a coalition, then communication is intra-organizational. Communication can be PUC-to-PUC, as happens on-site, or CP-to-CP, as in cooperative planning. Moreover, it can range from collaboration to deconfliction (“if you keep to the east of the river, we’ll keep to the west”). This will be the subject of further research.
- Observations and Instructions were not identified by Reuter et al (2011).

The refined framework leaves unanswered a number of implementation decisions. Firstly, it does not indicate to which of the control loops – direct, supervisory, or both – social media should be applied. This could be dependent on the organizational boundaries. The nature of the environment may also make it impossible to employ social media. For example, the supporting infrastructure (mobile phone reception or the availability of electrical power) might have been destroyed, or the citizens might be too poor to afford social media and the associated hardware devices. Secondly, the refined framework does not stipulate exactly what social media technology is suitable. One could envisage a design choice between one- or two-way communication (e.g. email versus chat), between broadcast or pointcast (e.g. webpage versus Facebook), and between synchronous or asynchronous communication (e.g. telephone versus voicemail).

<sup>2</sup> Intuitively, it seems desirable for inter-organizational communications to run horizontally, e.g. from one element (policy, control, or action) of one organization to the corresponding element of the other. In practice, this intuitive principle is violated. For example, in a civil-military coalition a military organization with its top-down hierarchy may cooperate with a civil organization in which decisions are made primarily in the field.

## CONCLUSIONS AND FURTHER RESEARCH

Social media has become a serious element in disaster response and political uprisings. The scientific research on the public use of social media in crisis situations has been largely empirical and descriptive. By contrast, theoretical insights are in their infancy. One theoretical development has been Reuter *et al.*'s (2011) framework for a social software infrastructure that helps official crisis management by integrating information from different online communities.

Our research is aimed at investigating whether social media has a role to play in military Command & Control (C2). To operate in a real-time, dynamic environment, crisis management organizations must close the control loop. Moreover, they must divide the organisation into an action part – the Process Under Control (PUC) – and a control part – the Controlling Process (CP). We have extended the Reuter *et al.*'s (2011) framework by splitting the Organization into two parts – PUC and CP – so turning their two-by-two matrix into three-by-three. In addition, we close the direct loop between citizens and PUC and the supervisory control loop between PUC and CP. We add Observations (PUC-to-CP), Instructions (CP-to-PUC), and On-site or Self-synchronisation (PUC-to-PUC) to Reuter *et al.*'s four categories. On-site or Self-synchronisation can be seen as an intra-organisational variant of Reuter *et al.*'s Inter-organisation category.

In further research we intend to validate the extended framework by applying it to a realistic example of humanitarian crisis management, such as transporting food to Darfur. Compared with the state-of-the-art social media employed in responding to the 2010 Haiti earthquake, integrating social media into the supervisory control loop would make it possible to close the control loop, to monitor task execution, to generate alerts, to enable self-synchronisation, and to maintain an event log for After Action Review.

This paper's contribution has been to show how social media could be applied in C2 to close the control loop. Its key limitations are that it is purely theoretical and gives no guidance on implementation. In particular, it does not indicate whether social media should be applied to the supervisory control loop, the direct control loop, or both. Nor does it stipulate exactly what social media technology is suitable. The extended framework has not yet been evaluated by expert practitioners nor tested by implementing it, let alone using it in training exercises or in the field. Further research is needed to overcome these limitations. We intend to start by prototyping the extended framework in collaboration with expert practitioners.

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